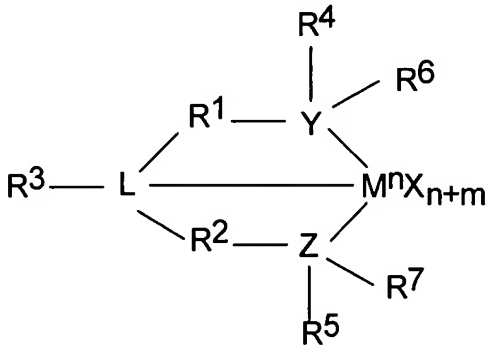
Amendments to the Claims

This listing of claims will replace all prior versions, and listings, of claims in the application:

Listing of Claims:

1. (Currently Amended) A continuous gas phase polymerization process comprising combining in a single gas phase reactor olefin monomers with a catalyst composition comprising an activator, a first catalyst compound comprising a Group 15-containing metal compound and a second catalyst compound; wherein the Group 15-containing metal compound is represented by the formula:



wherein

M is a Group 4 metal,

each X is independently a leaving group,

n is the oxidation state of M,

m is the formal charge of the ligand comprising Y, Z and L,

L is a Group 15 element,

Y is a Group 15 element,

Z is a Group 15 element,

R^1 and R^2 are independently a C_1 to C_{20} hydrocarbon group, or a heteroatom containing group having up to twenty carbon atoms, the heteroatom selected from the group consisting of silicon, germanium, tin, lead, and phosphorus;

wherein optionally, R^1 and R^2 are interconnected to each other, and/or R^4 and R^5 may be interconnected to each other,

R^3 is absent, a hydrocarbon group, a hydrogen, a halogen, or a heteroatom containing group,

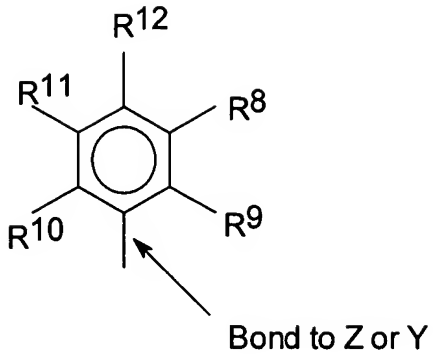
R^4 and R^5 are independently an alkyl group, an aryl group, a substituted aryl group, a cyclic alkyl group, a substituted cyclic alkyl group, a cyclic arylalkyl group, a substituted cyclic arylalkyl group or a multiple ring system, and

R^6 and R^7 are independently absent, hydrogen, an alkyl group, halogen, heteroatom or a hydrocarbyl group;

wherein a polyolefin is produced; and wherein the melt index (I_2) of the polyolefin is changed by altering the relative amounts of the first catalyst compound and the second catalyst ~~component~~ compound.

2. (Currently Amended) The process of Claim 1, wherein the second catalyst ~~system~~ compound comprises a bulky ligand metallocene compound, a Ziegler-Natta catalyst, a Phillips-type catalyst, a vanadium catalyst, or combinations thereof; wherein the Ziegler-Natta catalyst comprises MR_x, where M is a metal from Group 4 to 6, and R is a halogen or a hydrocarbyloxy group, and x is the oxidation state of the metal M; wherein the Phillips-type catalyst comprises CrO_3, chromocene, silyl chromate, chromyl chloride (CrO_2Cl_2), chromium-2-ethyl-hexanoate, or chromium acetylacetonate ($Cr(AcAc)_3$); and wherein the vanadium catalyst comprises vanadyl trihalide, alkoxy halides and alkoxides, vanadium tetra-halide and vanadium alkoxy halides, vanadium or vanadyl acetyl acetonates.

3. (Original) The process of Claim 1, wherein R^4 and R^5 are represented by the formula:



wherein R^8 to R^{12} are each independently hydrogen, a C_1 to C_{40} alkyl group, a halide, a heteroatom, or a heteroatom containing group containing up to 40 carbon atoms wherein any two R^{8-12} groups may form a cyclic group or a heterocyclic group.

4. (Original) The process of Claim 1, wherein the second catalyst compound comprises a bulky ligand metallocene compound of the general formula

$$L^DMQ_2(YZ)X_n$$

wherein M is a Group 4, 5 or 6 metal atom,

L^D is a cyclopentadienyl ligand that is bonded to M,

$Q_2(YZ)$ forms a unicharged polydentate ligand, wherein Q is selected from the group consisting of -O-, -NR-, $-CR_2-$ and -S-; Y is C; Z is selected from the group consisting of -OR, $-NR_2$, $-CR_3$, -SR, $-SiR_3$, $-PR_2$, -H, and substituted or unsubstituted aryl groups, with the proviso that when Q is -NR- then Z is selected from one of the group consisting of -OR, $-NR_2$, -SR, $-SiR_3$, $-PR_2$ and –H; R is a hydrocarbon group containing from 1 to 20 carbon atoms;

X is a univalent anionic group or a divalent anionic group, and

n is 1 or 2.

5. (Original) The process of Claim 1, wherein the second catalyst compound comprises a bulky ligand metallocene compound of the general formula:

$$L^AL^BMQ_n \text{ or } L^AAL^BMQ_n$$

wherein M is a Group 4, 5 or 6 metal atom;

L^A and L^B are selected from the group consisting of cyclopentadienyl, tetrahydroindenyl, indenyl, fluorenyl, and substituted versions thereof;

Q is a monoanionic leaving group;

A is a divalent bridging group containing at least one Group 13 to Group 16 atom; and

n is 0, 1 or 2.

6. (Original) The process of Claim 3, wherein R^9, R^{10} and R^{12} are independently a methyl, ethyl, propyl or butyl group.

7. (Original) The process of Claim 3, wherein R^9, R^{10} and R^{12} are methyl groups, and R^8 and R^{11} are hydrogen.

8. (Original) The process of Claim 1, wherein M is a Group 4 metal, L, Y, and Z are independently nitrogen, R^1 and R^2 are a hydrocarbon radical, R^3 is hydrogen, and R^6 and R^7 are absent.

9. (Original) The process of Claim 4, wherein M is a Group 4 metal and L^D is an indenyl group or a fluorenyl group.

10. (Original) The process of Claim 1, wherein the Group 15-containing metal compound to the second catalyst system are present in a molar ratio of 20:80 to 80:20.

11. (Original) The process of Claim 1, wherein the activator is selected from the group consisting of an alumoxane, a modified alumoxane, non-coordinating ionic activators, non-coordinating neutral activators, and combinations thereof.

12. (Original) The process of Claim 1, wherein the process is conducted at a temperature of from 30°C to 120°C.

13. (Original) The process of Claim 1, wherein the olefins consist of ethylene and at least one comonomer having from 4 to 8 carbon atoms.

14. (Original) The process of Claim 1, wherein hydrogen from 100 ppm to 5000 ppm is also combined.

15. (Original) The process of Claim 1, wherein the catalyst composition is introduced into the reactor in a solvent.

16. (Original) The process of Claim 1, wherein the catalyst composition also comprises a support.

17. (Original) The process of Claim 13, wherein the process is capable of producing a polyethylene copolymer having a Mw/Mn between 20 and 60, and a density of between 0.94 to 0.97 g/cm^3; wherein the ethylene is copolymerized with 1-butene or 1-hexene; wherein the second catalyst compound is a bulky ligand metallocene catalyst component and the activator is an alumoxane, the Al/Zr molar ratio ranging from 300:1 to 100:1, and the molar ratios of the metals from the first and second catalyst compounds ranges from 30:70 to 70:30.

18. (Original) The process of Claim 13, wherein the process is capable of producing a polyethylene copolymer having a residual metal content of 5.0 ppm transition metal or less; wherein the ethylene is copolymerized with 1-butene or 1-hexene; wherein the second catalyst compound is a bulky ligand metallocene catalyst component.

19. (Original) The process of Claim 17 or 18, wherein the polyethylene copolymer is formed into a pipe having a notch tensile test value of greater than 500 hrs at 3.0 MPa as measured under ASTM F1473.

20. (New) The process of Claim 1, wherein the first catalyst compound and the second catalyst compound and the activator are mixed off-line and then fed to the reactor.

21. (New) The process of Claim 1, wherein the first catalyst compound and the second catalyst compound are mixed off-line, followed by adding the activator in-line, and then feeding the composition to the reactor.

22. (New) The process of Claim 1, wherein the first catalyst compound is contacted with the activator off-line, followed by addition of the second catalyst compound in-line before entering the reactor.

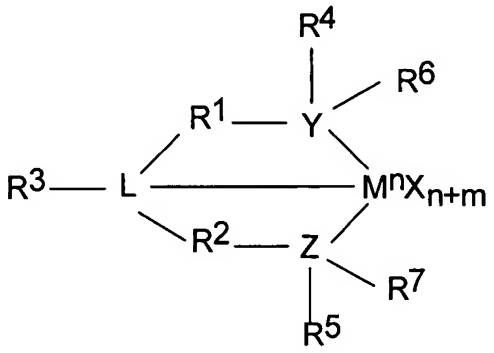
23. (New) The process of Claim 1, wherein the second catalyst compound is contacted with the activator off-line, followed by addition of the first catalyst compound in-line before entering the reactor.

24. (New) The process of Claim 1, wherein the first catalyst compound and the second catalyst compound are each contacted with the activator off-line, followed by the first catalyst compound and activator and the second catalyst compound and activator being contacted in line before entering the reactor.

25. (New) The process of Claim 1, wherein the first catalyst compound and the second catalyst compound are each contacted with the activator in-line, followed by the first catalyst compound and activator and the second catalyst compound and activator being contacted in-line before entering the reactor.

26. (New) The process of Claim 1, wherein the first catalyst compound is activated with activator off-line, followed by the first catalyst compound and activator being contacted in-line with the second catalyst compound, followed by feeding an activator in-line to the first and second catalyst compound activator mixture.

27. (New) A continuous gas phase polymerization process comprising combining in at least one polymerization reactor olefin monomers with a catalyst composition comprising an activator, a first catalyst compound comprising a Group 15-containing metal compound and a second catalyst compound; wherein the Group 15-containing metal compound is represented by the formula:



wherein

M is a Group 4 metal,

each X is independently a leaving group,

n is the oxidation state of M,

m is the formal charge of the ligand comprising Y, Z and L,

L is a Group 15 element,

Y is a Group 15 element,

Z is a Group 15 element,

R^1 and R^2 are independently a C_1 to C_{20} hydrocarbon group, or a heteroatom containing group having up to twenty carbon atoms, the heteroatom selected from the group consisting of silicon, germanium, tin, lead, and phosphorus; wherein optionally, R^1 and R^2 are interconnected to each other, and/or R^4 and R^5 may be interconnected to each other,

R^3 is absent, a hydrocarbon group, a hydrogen, a halogen, or a heteroatom containing group,

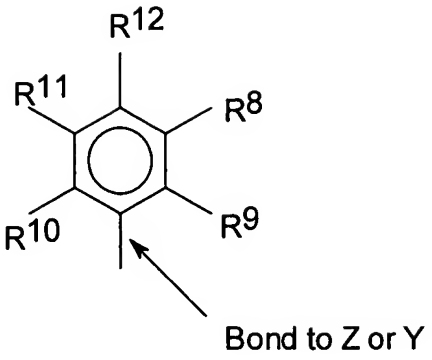
R^4 and R^5 are independently an alkyl group, an aryl group, a substituted aryl group, a cyclic alkyl group, a substituted cyclic alkyl group, a cyclic arylalkyl group, a substituted cyclic arylalkyl group or a multiple ring system, and

R^6 and R^7 are independently absent, hydrogen, an alkyl group, halogen, heteroatom or a hydrocarbyl group;

wherein a polyolefin is produced; and wherein the melt index (I_2) of the polyolefin is changed by altering the relative amounts of the first catalyst compound and the second catalyst compound.

28. (New) The process of Claim 27, wherein the second catalyst compound comprises a bulky ligand metallocene compound, a Ziegler-Natta catalyst, a Phillips-type catalyst, a vanadium catalyst, or combinations thereof; wherein the Ziegler-Natta catalyst comprises MR_x, where M is a metal from Group 4 to 6, and R is a halogen or a hydrocarbyloxy group, and x is the oxidation state of the metal M; wherein the Phillips-type catalyst comprises CrO_3, chromocene, silyl chromate, chromyl chloride (CrO_2Cl_2), chromium-2-ethyl-hexanoate, or chromium acetylacetonate ($Cr(AcAc)_3$); and wherein the vanadium catalyst comprises vanadyl trihalide, alkoxy halides and alkoxides, vanadium tetra-halide and vanadium alkoxy halides, vanadium or vanadyl acetyl acetonates.

29. (New) The process of Claim 27, wherein R^4 and R^5 are represented by the formula:



wherein R^8 to R^{12} are each independently hydrogen, a C_1 to C_{40} alkyl group, a halide, a heteroatom, or a heteroatom containing group containing up to 40 carbon atoms wherein any two R^{8-12} groups may form a cyclic group or a heterocyclic group.

30. (New) The process of Claim 27, wherein the second catalyst compound comprises a bulky ligand metallocene compound of the general formula

$$L^DMQ_2(YZ)X_n$$

wherein M is a Group 4, 5 or 6 metal atom,

L^D is a cyclopentadienyl ligand that is bonded to M,

$Q_2(YZ)$ forms a unicharged polydentate ligand, wherein Q is selected from the group consisting of -O-, -NR-, $-CR_2-$ and -S-; Y is C; Z is selected from the group consisting of -OR, $-NR_2$, $-CR_3$, -SR, $-SiR_3$, $-PR_2$, -H, and substituted or unsubstituted aryl groups, with the proviso that when Q is -NR- then Z is selected from one of the group consisting of -OR, $-NR_2$, -SR, $-SiR_3$, $-PR_2$ and –H; R is a hydrocarbon group containing from 1 to 20 carbon atoms;

X is a univalent anionic group or a divalent anionic group, and

n is 1 or 2.

31. (New) The process of Claim 27, wherein the second catalyst compound comprises a bulky ligand metallocene compound of the general formula:

$$L^AL^BMQ_n \text{ or } L^AAL^BMQ_n$$

wherein M is a Group 4, 5 or 6 metal atom;

L^A and L^B are selected from the group consisting of cyclopentadienyl, tetrahydroindenyl, indenyl, fluorenyl, and substituted versions thereof;

Q is a monoanionic leaving group;

A is a divalent bridging group containing at least one Group 13 to Group 16 atom; and

n is 0, 1 or 2.

32. (New) The process of Claim 27, wherein the activator is selected from the group consisting of an alumoxane, a modified alumoxane, non-coordinating ionic activators, non-coordinating neutral activators, and combinations thereof.

33. (New) The process of Claim 27, wherein the olefins consist of ethylene and at least one comonomer having from 4 to 8 carbon atoms.

34. (New) The process of Claim 27, wherein the catalyst composition also comprises a support.

35. (New) The process of Claim 27, wherein the process is capable of producing a polyethylene copolymer having an I_{21}/I_2 of 80 or more, and a density of between 0.94 to 0.97 g/cm^3.

36. (New) The process of Claim 35, wherein the process is capable of producing a polyethylene copolymer having an I_{21}/I_2 of 100 or more.

37. (New) The process of Claim 35, wherein the polyethylene copolymer is formed into a pipe having a notch tensile test value of greater than 500 hrs at 3.0 MPa as measured under ASTM F1473.

38. (New) The process of Claim 27, wherein the process is capable of producing a polyethylene copolymer having an I_{21} of from 2 to 50 dg/min; wherein the polyethylene copolymer is formed into a film, the film characterized in that a film of 0.5 mil formed from such polyethylene copolymer possesses an MD Tear of between 20 g/mil and 25 g/mil.

39. (New) The process of Claim 27, wherein the first catalyst compound and the second catalyst compound and the activator are mixed off-line and then fed to the reactor.

40. (New) The process of Claim 27, wherein the first catalyst compound and the second catalyst compound are mixed off-line, followed by adding the activator in-line, and then feeding the composition to the reactor.

41. (New) The process of Claim 27, wherein the first catalyst compound is contacted with the activator off-line, followed by addition of the second catalyst compound in-line before entering the reactor.

42. (New) The process of Claim 27, wherein the second catalyst compound is contacted with the activator off-line, followed by addition of the first catalyst compound in-line before entering the reactor.

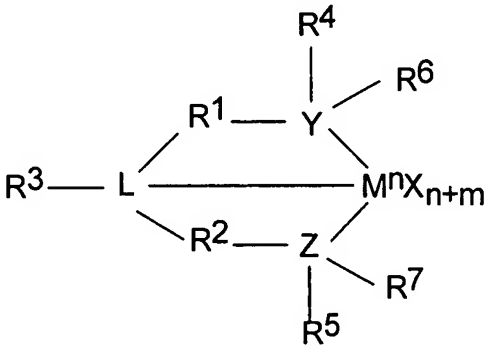
43. (New) The process of Claim 27, wherein the first catalyst compound and the second catalyst compound are each contacted with the activator off-line, followed by the first catalyst compound and activator and the second catalyst compound and activator being contacted in line before entering the reactor.

44. (New) The process of Claim 27, wherein the first catalyst compound and the second catalyst compound are each contacted with the activator in-line, followed by the first catalyst compound and activator and the second catalyst compound and activator being contacted in-line before entering the reactor.

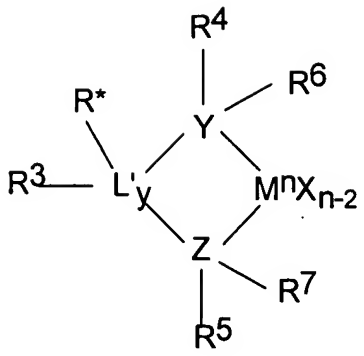
45. (New) The process of Claim 27, wherein the first catalyst compound is activated with activator off-line, followed by the first catalyst compound and activator being contacted in-line with the second catalyst compound, followed by feeding an activator in-line to the first and second catalyst compound activator mixture.

46. (New) The process of Claim 27, wherein the catalyst composition is sprayed into the reactor in such a way as to create a particle lean zone, the particle lean zone created by a 50,000 lb/hr flow of cycle gas through 6 inch pipe into the reactor.

47. (New) A polymerization process comprising combining in at least one polymerization reactor olefin monomers with a catalyst composition comprising an activator, a first catalyst compound comprising a Group 15-containing metal compound and a second catalyst compound; wherein the Group 15 containing metal compound is represented by the formulae:



or



wherein

M is a Group 4, 5 or 6 metal,

each X is independently a leaving group

y is 0 or 1,

n is the oxidation state of M,

m is the formal charge of the YZL or the YZL' ligand,

L is a Group 15 or 16 element,

L' is a Group 15 or 16 element or Group 14 containing group,

Y is a Group 15 element,

Z is a Group 15 element,

R^1 and R^2 are independently a C_1 to C_{20} hydrocarbon group, a heteroatom containing group having up to twenty carbon atoms, silicon, germanium, tin, lead, or phosphorus,

R^3 is absent or a hydrocarbon group, hydrogen, a halogen, a heteroatom containing group,

R^4 and R^5 are independently an alkyl group, an aryl group, substituted aryl group, a cyclic alkyl group, a substituted cyclic alkyl group, a cyclic arylalkyl group, a substituted cyclic arylalkyl group or multiple ring system,

R^6 and R^7 are independently absent, or hydrogen, an alkyl group, halogen, heteroatom or a hydrocarbyl group,

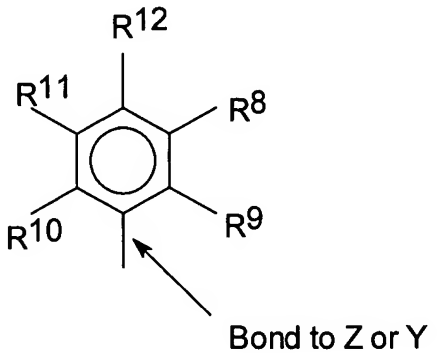
R^* is absent, or is hydrogen, a Group 14 atom containing group, a halogen, a heteroatom containing group;

wherein a bimodal polyethylene is produced; and wherein the melt index (I_2) of the bimodal polyethylene is changed by altering the relative amounts of the first catalyst compound and the second catalyst compound.

48. (New) The process of Claim 47, wherein R^1 and R^2 are interconnected to each other, or wherein R^4 and R^5 are interconnected to each other.

49. (New) The process of Claim 47, wherein the second catalyst compound comprises a bulky ligand metallocene compound, a Ziegler-Natta catalyst, a Phillips-type catalyst, a vanadium catalyst, or combinations thereof; wherein the Ziegler-Natta catalyst comprises MR_x, where M is a metal from Group 4 to 6, and R is a halogen or a hydrocarbyloxy group, and x is the oxidation state of the metal M; wherein the Phillips-type catalyst comprises CrO_3, chromocene, silyl chromate, chromyl chloride (CrO_2Cl_2), chromium-2-ethyl-hexanoate, or chromium acetylacetonate ($Cr(AcAc)_3$); and wherein the vanadium catalyst comprises vanadyl trihalide, alkoxy halides and alkoxides, vanadium tetra-halide and vanadium alkoxy halides, vanadium or vanadyl acetyl acetonates.

50. (New) The process of Claim 47, wherein R^4 and R^5 are represented by the formula:



wherein R^8 to R^{12} are each independently hydrogen, a C_1 to C_{40} alkyl group, a halide, a heteroatom, or a heteroatom containing group containing up to 40 carbon

atoms wherein any two R^{8-12} groups may form a cyclic group or a heterocyclic group.

51. (New) The process of Claim 47, wherein the second catalyst compound comprises a bulky ligand metallocene compound of the general formula

$$L^DMQ_2(YZ)X_n$$

wherein M is a Group 4, 5 or 6 metal atom,

L^D is a cyclopentadienyl ligand that is bonded to M,

$Q_2(YZ)$ forms a unicharged polydentate ligand, wherein Q is selected from the group consisting of -O-, -NR-, -CR_2- and -S-; Y is C; Z is selected from the group consisting of -OR, -NR_2, -CR_3, -SR, -SiR_3, -PR_2, -H, and substituted or unsubstituted aryl groups, with the proviso that when Q is -NR- then Z is selected from one of the group consisting of -OR, -NR_2, -SR, -SiR_3, -PR_2 and –H; R is a hydrocarbon group containing from 1 to 20 carbon atoms;

X is a univalent anionic group or a divalent anionic group, and

n is 1 or 2.

52. (New) The process of Claim 47, wherein the second catalyst compound comprises a bulky ligand metallocene compound of the general formula:

$$L^AL^BMQ_n \text{ or } L^AAL^BMQ_n$$

wherein M is a Group 4, 5 or 6 metal atom;

L^A and L^B are selected from the group consisting of cyclopentadienyl, tetrahydroindenyl, indenyl, fluorenyl, and substituted versions thereof;

Q is a monoanionic leaving group;

A is a divalent bridging group containing at least one Group 13 to Group 16 atom; and

n is 0, 1 or 2.

53. (New) The process of Claim 47, wherein the activator is selected from the group consisting of an alumoxane, a modified alumoxane, non-coordinating ionic activators, non-coordinating neutral activators, and combinations thereof.

54. (New) The process of Claim 47, wherein the olefins consist of ethylene and at least one comonomer having from 4 to 8 carbon atoms.

55. (New) The process of Claim 47, wherein the catalyst composition also comprises a support.

56. (New) The process of Claim 47, wherein the process is capable of producing a polyethylene copolymer having an I_{21}/I_2 of 80 or more, and a density of between 0.94 to 0.97 g/cm^3.

57. (New) The process of Claim 56, wherein the process is capable of producing a polyethylene copolymer having an I_{21}/I_2 of 100 or more.

58. (New) The process of Claim 56, wherein the polyethylene copolymer is formed into a pipe having a notch tensile test value of greater than 500 hrs at 3.0 MPa as measured under ASTM F1473.

59. (New) The process of Claim 47, wherein the process is capable of producing a polyethylene copolymer having an I_{21} of from 2 to 50 dg/min; wherein the polyethylene copolymer is formed into a film, the film characterized in that a film of 0.5 mil formed from such polyethylene copolymer possesses an MD Tear of between 20 g/mil and 25 g/mil.

60. (New) The process of Claim 47, wherein the first catalyst compound and the second catalyst compound and the activator are mixed off-line and then fed to the reactor.

61. (New) The process of Claim 47, wherein the first catalyst compound and the second catalyst compound are mixed off-line, followed by adding the activator in-line, and then feeding the composition to the reactor.

62. (New) The process of Claim 47, wherein the first catalyst compound is contacted with the activator off-line, followed by addition of the second catalyst compound in-line before entering the reactor.

63. (New) The process of Claim 47, wherein the second catalyst compound is contacted with the activator off-line, followed by addition of the first catalyst compound in-line before entering the reactor.

64. (New) The process of Claim 47, wherein the first catalyst compound and the second catalyst compound are each contacted with the activator off-line, followed by the first catalyst compound and activator and the second catalyst compound and activator being contacted in line before entering the reactor.

65. (New) The process of Claim 47, wherein the first catalyst compound and the second catalyst compound are each contacted with the activator in-line, followed by the first catalyst compound and activator and the second catalyst compound and activator being contacted in-line before entering the reactor.

66. (New) The process of Claim 47, wherein the first catalyst compound is activated with activator off-line, followed by the first catalyst compound and activator being contacted in-line with the second catalyst compound, followed by feeding an activator in-line to the first and second catalyst compound activator mixture.

67. (New) The process of Claim 47, wherein the catalyst composition is sprayed into the reactor in such a way as to create a particle lean zone, the particle lean zone created by a 50,000 lb/hr flow of cycle gas through 6 inch pipe into the reactor.

68. (New) The process of Claim 47, wherein the olefin monomers, and catalyst composition comprising are combined in a single reactor.